

# EECS 388: Computer Systems and Assembly Language

## Lab 9

### Connecting to the Outside World: Controlling LEDs with the Project Board

**Objective:** To learn how to control devices using the project board.

#### I. How to Prepare for the Lab

##### Equipment

Before coming to lab, get 15 inches of wire from the EECS shop on the 3<sup>rd</sup> floor of Eaton. It's in the metal cabinet to the right of the shop window. Cut the wire into five 3-inch pieces, and strip the ends of the wire. Keep in mind that the wire must fit well into the breadboard, so approximately 22 gauge will work. The LEDs and resistors for the lab will be provided for you during your lab session.

##### Code

Download and run the lab program example lab9ex.asm. Make sure you understand how the LEDs are "fired," as well as how the delays are used between LED firings.

**Note:** This lab and code is based on the LED lab from the Axiom website. Illustrations are taken from their lab as well. You may read this for additional information:

[http://www.axman.com/education/labs/hc12\\_LEDS2D.html](http://www.axman.com/education/labs/hc12_LEDS2D.html)

## II. Problem 1:

In this lab we will connect LEDs to the project board, and write a program to blink them in sequence, in forward and reverse order.

### Part A: Setting Up the Board

1. Unplug the board -- verify that power is NOT applied to development board.
2. Install the four LEDs and four resistors on the breadboard.
3. Install the jumper wires on the board as follows:

#### MCU PORT-----Breadboard

GND-----GND  
PK0-----D1  
PK1-----D2  
PK2-----D3  
PK3-----D4

The following illustrations show what your board will look like:

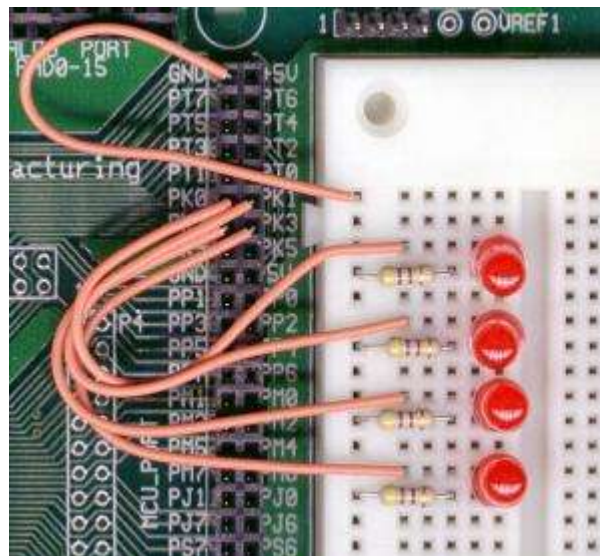
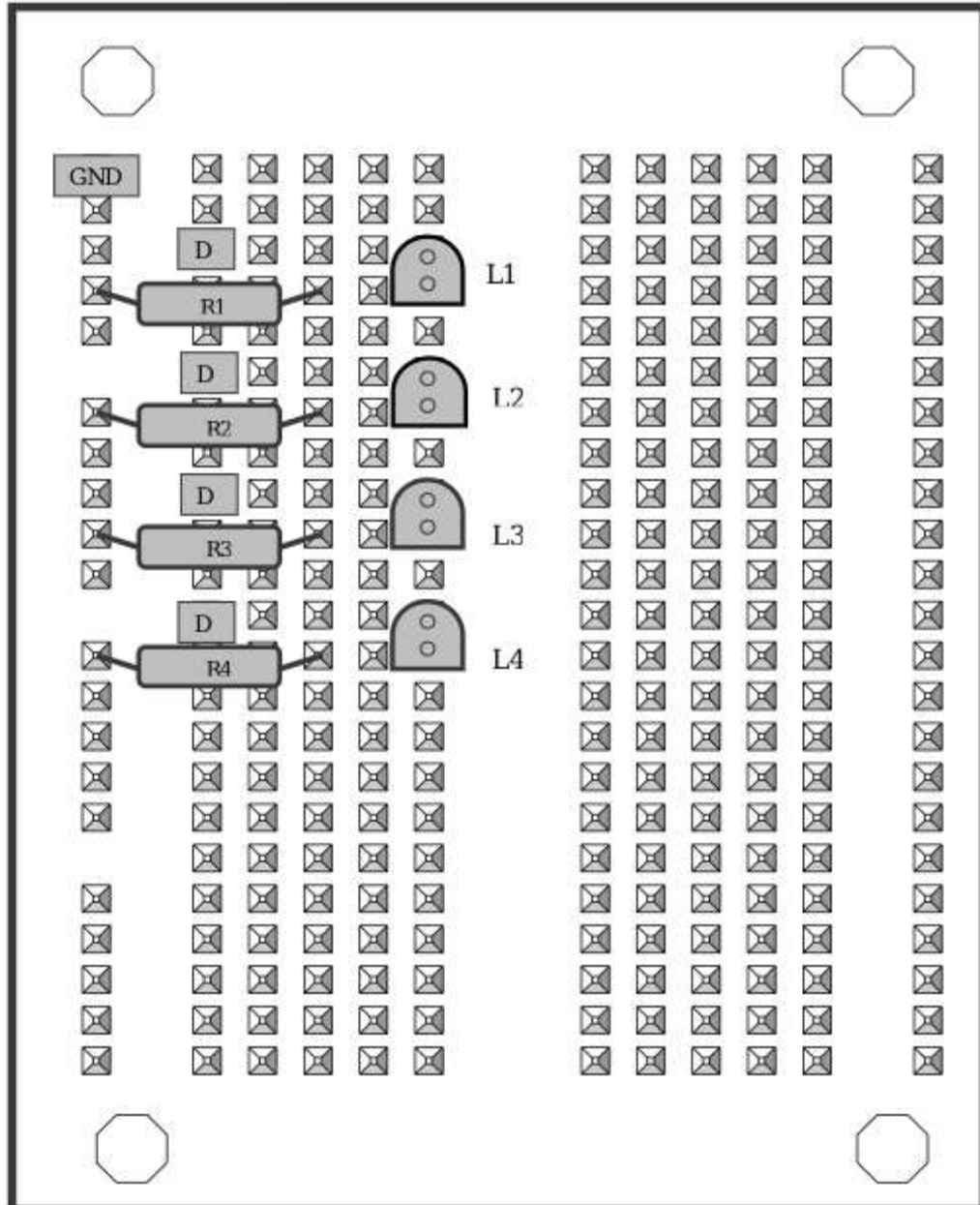


Figure 1



## **Part B: Running the Example Program**

To ensure that your board is correctly set up, download the program lab9ex.asm. Assemble it, and load it on the board.

Note that the code starts at location 1000. Execute it by typing in the monitor:

### **GO 1000**

All four LEDs should light up in sequence. This program loops indefinitely, so press the “reset” button on your board to stop it. If the LEDs are not lighting up correctly, then unplug your board, and verify that you did all steps correctly to set it up in part A above.

## **Part C: Writing the Program**

Write a program that will fire the LEDs in forward order (from the top of the board down) or reverse order, depending on user input. There should be a short delay between each light firing. First prompt the user, instructing them what to enter. The user will enter an uppercase or lowercase “F” for forward or an uppercase or lowercase “B” for backward. After the user enters the character, the LEDs will complete one blinking sequence -- each light will blink once in order. After every LED has blinked once, the lights will stop blinking. The program will then prompt the user again. When the user enters a period, the program will exit.

Your program should include a function called “FIRE,” which will blink any LED once, based on an argument passed via the stack or register.

### Example Program Run:

```
>go 1000
```

```
Enter LED direction (F/B; "." to quit):  
F
```

```
Enter LED direction (F/B; "." to quit):  
b
```

```
Enter LED direction (F/B; "." to quit):  
f
```

```
Enter LED direction (F/B; "." to quit):  
B
```

```
Enter LED direction (F/B; "." to quit):  
.
```

### Demonstrating Your Results:

To demonstrate your results, run the program, and show that it behaves correctly for both uppercase and lowercase inputs.

### Report Format and Grading:

Following the report format in your syllabus, include the following in your report:

1. Your name, student number, lab project number and title, course number, lab section number, and date.
2. Description of the lab in your own words. What did you learn? If your code did not work in the lab, explain why. (45% of report grade)
3. The source code for your program. **Use comments to indicate what changes you made to the program template.** (45% of report grade)
4. A short evaluation of the lab. What did you like about the lab? What could be improved? (10% of report grade)